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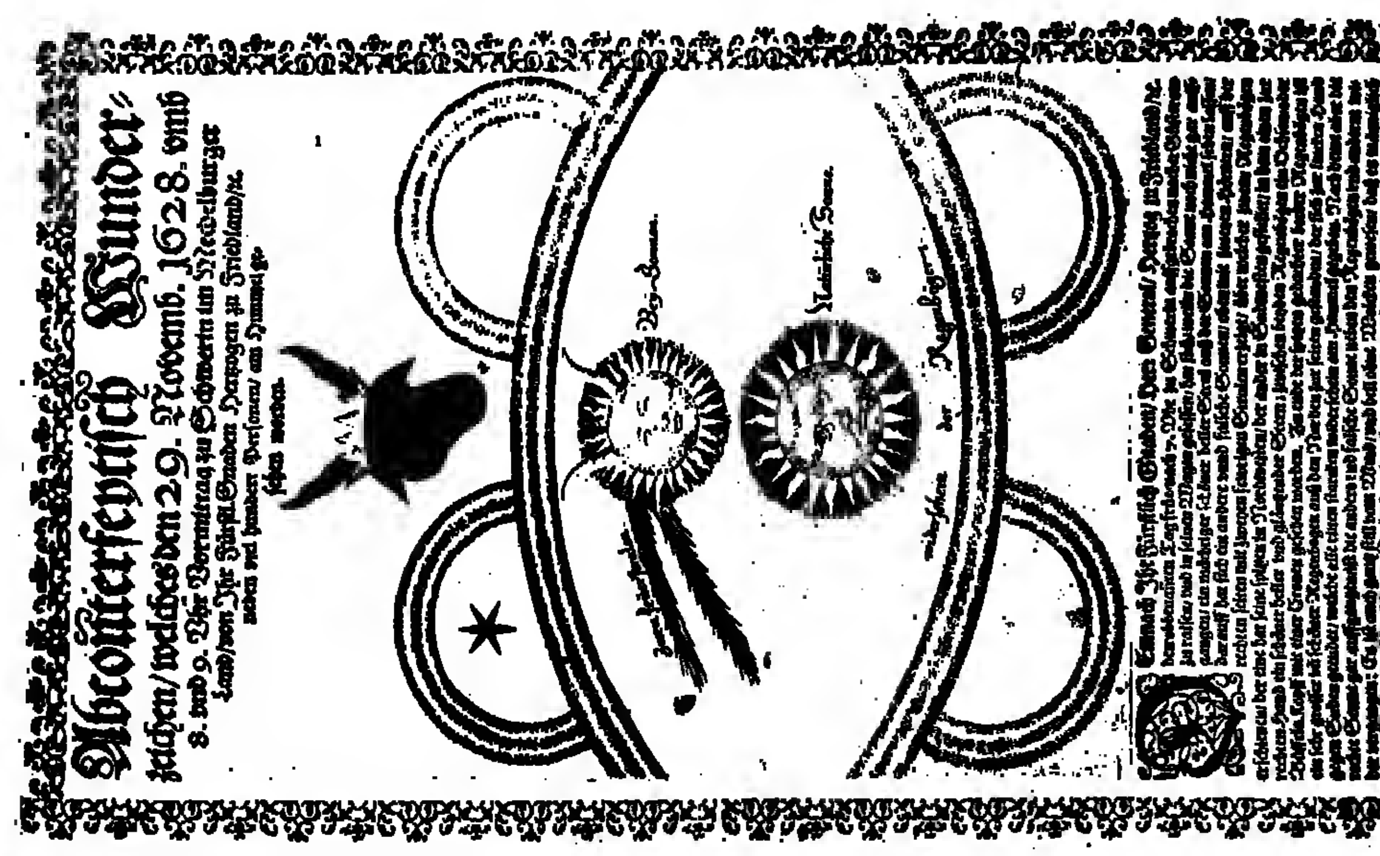

Oceanography

4703 Boundary layer and exchange processes
BUBBLE AND AEROSOL SPECTRA PRODUCED BY A LABORATORY "BREAKING WAVE"
Keith J. Cipriano and Duncan C. Blanchard (Atmospheric Sciences Research Center, State University of New York at Albany, Albany, NY 12222)
The relative contribution of jet and film drops from bursting bubbles to the sea-salt component of the marine aerosol is poorly understood. An analysis of the bubble and aerosol spectra produced by a laboratory model of a breaking wave or whitecap shows that film drops may play a much more important role than previously recorded. The model strongly suggests that most of the droplets smaller than 5-10 μm in diameter originate as film drops, derived from bubbles larger than 2 mm. The water-to-air flux of such droplets is adequate to account for the majority of maritime cloud condensation nuclei. The model also suggests that droplets larger than 20-25 μm originate as jet drops, derived from bubbles smaller than 2 mm. The model breaking wave produces an upwelling plume of bubbles whose concentration for all bubble sizes easily exceeds the steady-state or background bubble population observed at sea at depths greater than 1 meter. Bubbles of up to 10 mm diameter were produced and the bubble flux reached 200 cm⁻²s⁻¹. Whitecaps are essential in making more accurate estimates of marine aerosol production. (Marine aerosol, bubble spectra, film drops, cloud condensation nuclei.)
J. Geophys. Res., Green, Paper 1C0711

4705 Boundary layer and exchange processes
THE FORM OF THE NEAR-BED VELOCITY PROFILE IN A TIDALLY ACCELERATING FLOW
D. L. Soulsby (Institute of Oceanographic Sciences, Crossway, Taunton, UK) and K. R. Dyer
In an accelerating tidal flow the near bed velocity profile departs from the usual logarithmic form. The amount of the departure may not necessarily be large, but is nevertheless important when the profiles are used to calculate the bed roughness length and bed stress. A form for the accelerating profile is derived in terms of an 'acceleration length'. Profiles measured off the SW coast of England are fitted to this expression, and give a value for an entrainment-like constant γ appearing in it. Published laboratory oscillatory flow profiles are also fitted in this case the constant γ is larger due to the greater relative bed roughness. Von Karman's constant is obtained from the field data and found to be equal to 0.40, closer to laboratory values than to the low widely used atmospheric value of 0.35. Some evidence is found, however, to support a slow decrease in von Karman's constant with increasing boundary-layer thickness to roughness length ratio. (Velocity profiles, bottom boundary layer, accelerating flows, tidal currents)
J. Geophys. Res., Green, Paper 1C0771

4710 Chemical oceanography
OCEANIC CO2 PRODUCED BY THE PRECIPITATION OF CaCO3 FROM BRINES IN SEA ICE
J. K. Jones (Bedford Institute of Oceanography, P.O. Box 1006, Dartmouth, Nova Scotia, B2Y 4A2, Canada) and E. P. Coote
Carbon dioxide is produced in brines formed during the growth of sea ice as a result of preferential precipitation of calcium carbonate. This process may explain the observed CO2 supersaturation in some Arctic waters and could produce a CO2 flux into the ocean in ice-covered waters of 1.5 mol m⁻²yr⁻¹ or a total of 6 x 10¹³ mol y⁻¹ for both the arctic and antarctic regions. (Greenic 10., sea ice, 10., flux, carbon cycle).
J. Geophys. Res., Green, Paper 1C0768

4720 Distribution and water masses
ON THE DISTRIBUTION OF COPPER, NICKEL, AND CADMIUM IN THE SURFACE WATERS OF THE NORTH ATLANTIC AND NORTH PACIFIC OCEAN
Edward A. Boyle, Sarah S. Huested, and Susan P. Jones (Dept. Institute of Technology, Dept. of Earth and Planetary Science, Cambridge, Mass. 02139)
Concentrations of copper, nickel, and cadmium have been determined for about 250 surface water samples. Non-upwelling open-ocean concentrations of these metals are Cu, 0.5-0.8 nmol/kg; Ni, 1.5-2 nmol/kg; and Cd, less than 10 pmol/kg. In the equatorial Pacific upwelling zone, concentrations of Ni (3 nmol/kg) and Cd (80 pmol/kg) are higher than in the open ocean, but Cu (0.9 nmol/kg) is not significantly enriched. Metal concentrations are higher in cool, nutrient-rich eastern boundary currents: Cu, 1.3 nmol/kg; Ni, 3.5 nmol/kg, and Cd, 10-50 nmol/kg. Copper is distinctly higher in the coastal waters of the Gulf of Panama (3-4 nmol/kg) and also higher in the shelf waters north of the Gulf Stream (2.5 nmol/kg). These copper enrichments are attributable to the diffusion of diagenetically remobilized copper flux out of mildly reducing shelf sediments, and a subsequent nutrient trap enhancement. In the open ocean, excess of high-Cu water (1.5-1.5 nmol/kg) are seen as scales up to 40 km; presumably these are due to the advection of coastal water into the oceanic interior. Copper concentrations in the North Pacific central gyre (0.5 nmol/kg) are lower than in the Sargasso Sea (1.1 nmol/kg), while for nickel the reverse order is observed: 2 nmol/kg in the North Pacific and 1.5 nmol/kg in the North Atlantic. The residual concentrations of trace metals in the surface waters of the ocean can be modeled by assuming that organisms incorporate these metals relative to phosphorus as the metal to phosphorus ratio increases.
J. Geophys. Res., Green, Paper 1C0755

4780 Sea ice
ESTIMATING SURFACE WIND DIRECTION OVER DRIFTING OPEN PACK ICE
Uri Seldman (Department of Geography, Bar-Ilan University, Ramat-Gan, Israel) Philip J. Howarth and John W. Gavin.
Surface wind direction data, vital for the study of drifting pack ice, are not routinely available for polar oceans. These data may be estimated from the difference between the directions of motion of detached ice floes, as determined from sequential satellite images, and the angle of sea ice deflection, which varies with wind direction, surface weather charts.
J. Geophys. Res., Green, Paper 1C0468

4785 Surface waves, tides, and sea level
TIDES OF THE CARIBBEAN SEA
B. Kjerfve (Belle W. Baruch Institute for Marine Biology and Coastal Research, Marine Science Program, and Department of Geology, University of South Carolina, Columbia, S.C. 29208, U.S.A.)
Analysis of tidal characteristics from 45 gauge locations indicates that the Caribbean Sea tides are micro-tidal range, for the most part between 10 and 25 cm. The tide is primarily either mixed semidiurnal or mixed diurnal but a substantial section from Puerto Rico to Venezuela experiences diurnal tides. Empirical charts of six component tides (M₂, S₂, N₂, K₁, O₁, and P₁) show local detail of phase and amplitude. Each of the semidiurnal component tides is characterized by anticlockwise rotating amphidromes centered in the eastern Caribbean. There is evidence of strong radiational forcing of the S₂ tide in the southwestern Caribbean. The diurnal component tides are largely uniform in both phase and amplitude for most of the eastern and central Caribbean. However, the diurnal phases increase rapidly toward the northwest and the Yucatan Channel.
J. Geophys. Res., Green, Paper 80C1810

4799 Oceanography
HETEROGENEOUS ALTERATION OF THE UPPER OCEANIC CRUST: CORRELATION OF ROCK CHEMISTRY, MAGNETIC PROPERTIES, AND O-ISOTOPE RATIOS WITH ALTERATION PATTERNS IN BASALTS FROM SITE 396B, DSDP
J. S. BÖHLKE (540 Dwight Place, Berkeley, CA 94704), J. Honnorez, B.-M. Honnorez-Guerstein, K. Muehlenbachs, and N. Petersen
Mineralogy, chemistry, and some magnetic properties of altered basaltic rocks from DSDP Site 396B are rather simply related to one another, but differ dramatically with the nature of the igneous material, and with the sharp alteration zonation within individual basalt fragments. Low temperature alteration of the major igneous minerals appears to have been primarily a function of oxidation, which affects titanomagnetite pervasively (grey interiors) and olivine locally (brown zones).
Destruction of olivine in the pillow basalts released Mg²⁺, SiO₂, Co, and Ni to the circulating solution and resulted in a calculated 9-10% decrease in density of the most altered (brown) zones in the rock. Somewhat phosphate was incorporated in secondary ferric oxides replacing the olivine. In the massive basalts all of the SiO₂ and much of the Mg from olivine recombined as smectite and the inferred rock density is almost unchanged. In almost all of the crystalline rocks, primary Ca, Na, Fe, Ti and Al were immobile, owing to the metastability of plagioclase and clinopyroxene. The filling of cracks by smectite, Fe-Mn oxides, phillipsite, and calcite consumed elements from various sources, and was probably more important than basalt alteration for some chemical fluxes.
δO¹⁸ values of the altered rocks are roughly 3‰ higher than their fresh equivalents, owing to the addition of O¹⁸-rich secondary oxides and smectites, and lesser carbonates and phillipsite. The highest values are associated with the smectite-rich samples. δO¹⁸ is not a good indicator of the degree of alteration because of strong leaching in the most altered zones of the pillow basalts.
Pervasive oxidation of titanomagnetite to titanomaghemite has caused all samples to have high Curie temperatures, indicating up to about 70% oxidation. With the destruction of olivine in the brown zones, strong oxidation has caused breakdown of titanomaghemite to more stable nonmagnetic oxides, hence a drop in saturation intensity. These reactions have proceeded further in the pillow basalts than in the massive basalts.
Freshly erupted oceanic crust consisting of various basaltic materials with abundant void space and (or) interstitial sediments, is clearly heterogeneous; this primary heterogeneity is accentuated by alteration. (Basalt, alteration, DSDP).
J. Geophys. Res., Red, Paper 1B0646

Atmospheric Oscillations After the May 18, 1980 Eruption of Mount St. Helens

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Toshiro Tanimoto

Seismographic Station,
University of California, Berkeley

Observations

Air waves corresponding both to direct (A1) and antipodean (A2) travel paths were clearly recorded on a sensitive microbarograph at Berkeley after the violent eruption of Mount St. Helens on May 18, 1980 (see Figure 1). These unusual complementary recordings throw light on the acoustic energy released as compared with Krakatoa [*Strachey*, 1888], atmospheric oscillations and their attenuation, and the directive properties of the phreatic blast. The principal explosive eruptions followed closely on an earthquake, Richter magnitude 4.9, origin time 1532 GMT, centered near the volcano. Atmospheric waves and associated magnetic perturbations [*Fougere and Tsacoyeanes*, 1980] from these eruptions were recorded by microbarographs, seismographs, and magnetometers around the world. In particular, *Ritsema* [1980] has published records of the A1 atmospheric wave train and the A2 wave (called 81 by him) recorded at De Bilt, Holland. The A2 waves at De Bilt, however, are barely visible on the paper record.

The microbarograph in the Berkeley seismographic vault also clearly recorded atmospheric waves produced during the sudden vertical fault displacement in the great 1964 Alaskan earthquake [*Bolt*, 1964]. The barograph is designed to respond to pressure fluctuations of periods down to 10 s. The signal is recorded continuously on a paper chart which moves at 6 mm/min. The sensitivity in May 1980 was set so that 1 mm of deflection corresponds to a sudden pressure variation of 0.0090 mbar. Local fluctuations in air pressure were very small at the time of arrival of both the A1 and A2 wave trains from the Mount St. Helens eruption, with signal to noise ratio of at least 10 to 1. The mean velocities of wave components to Berkeley are given in the table together with the periods. No atmospheric waves were detected on the Berkeley microbarograph corresponding to A4, but A3 may have been recorded.

The A1 wave train shows an intriguing complexity. The periods of the air waves range from 2 min to almost 20 min. There are two sharp maxima with widths of approximately 3 min, about 6 min apart. Their onsets, designated *a* and *c* in Table 1, have group velocities of 308 m/s and 262 m/s, respectively. Their appearance is so similar that they suggest a double source (see discussion below). The velocity and wave length of the first pulse (A1a) are consistent with the arrival of the first atmospheric gravity mode GR_0, with group velocity predicted by the standard ARDC atmosphere [*Harkrider and Press*, 1967]. This pulse, associated with a flat dispersion curve, is immediately followed by oscillations with periods of about 1 min that correspond to purely acoustic modes. The second pulse A1c is again followed by high-frequency oscillations superimposed on a very long period excursion (about 18 min), which corresponds to the group of waves traveling with a velocity of 254 m/s. Theory predicts [*Harkrider and Press*, 1967] that these late-arriving waves correspond to the gravity mode GR_1 or GR_2.

Source Properties

The elegant double pulse in the A1 train shown in Figure 1 could arise from either source or path properties. We favor the former, based on a number of trial experiments. In one we subtracted from the record a repetition of the first pulse and its coda (adjusted for amplitude) at the lag appropriate to the second pulse. The resulting record was consistent with the double source hypothesis, i.e., that there were two eruptive events 6 min apart.

These biases need not be, of course, in the same direction. Independent evidence comes from field observations near Mount St. Helens [*Christiansen*, 1980]. The first pulse (A1a) no doubt was produced by the great lateral blast which initiated the eruption. A vertical eruption was then observed which, within 10 min of the initial lateral blast, had risen to a height of 20 km. The second pulse (A1c) could well correspond to this blast.

A study of the spectrum from the direct wave A1 and the antipodean wave in the opposite direction, A2, provides evidence on source propagation. A well-known procedure is to take the ratio (thus removing instrument effects) of the two spectra (A2 to A1) and examine the spectral modulation produced by the finite velocity of propagation of the source. Because the field evidence that the great initial eruption extended 20 km to the north (away from Berkeley) is unequivocal, we might expect to see the effect of this in the A2/A1 spectrum (Figure 2). The condition for minima is that $nT/c = L/c - \alpha$), where L is the length traversed by the source, c is the velocity of the air wave, and α is the velocity of the front of the blast; T is the period of the wave, and n is an integer that must be assigned. Taking the first minimum at T = 398 s, n = 1, and c = 300 m/s, we obtain a source velocity of 40 m/s for a source propagation distance of 20 km. If the second minimum at T = 288 s is used, the blast velocity is about 32 m/s. Propagation velocities of glowing avalanches have, in the past, been estimated to be about 180 km/h, in agreement with this calculation.

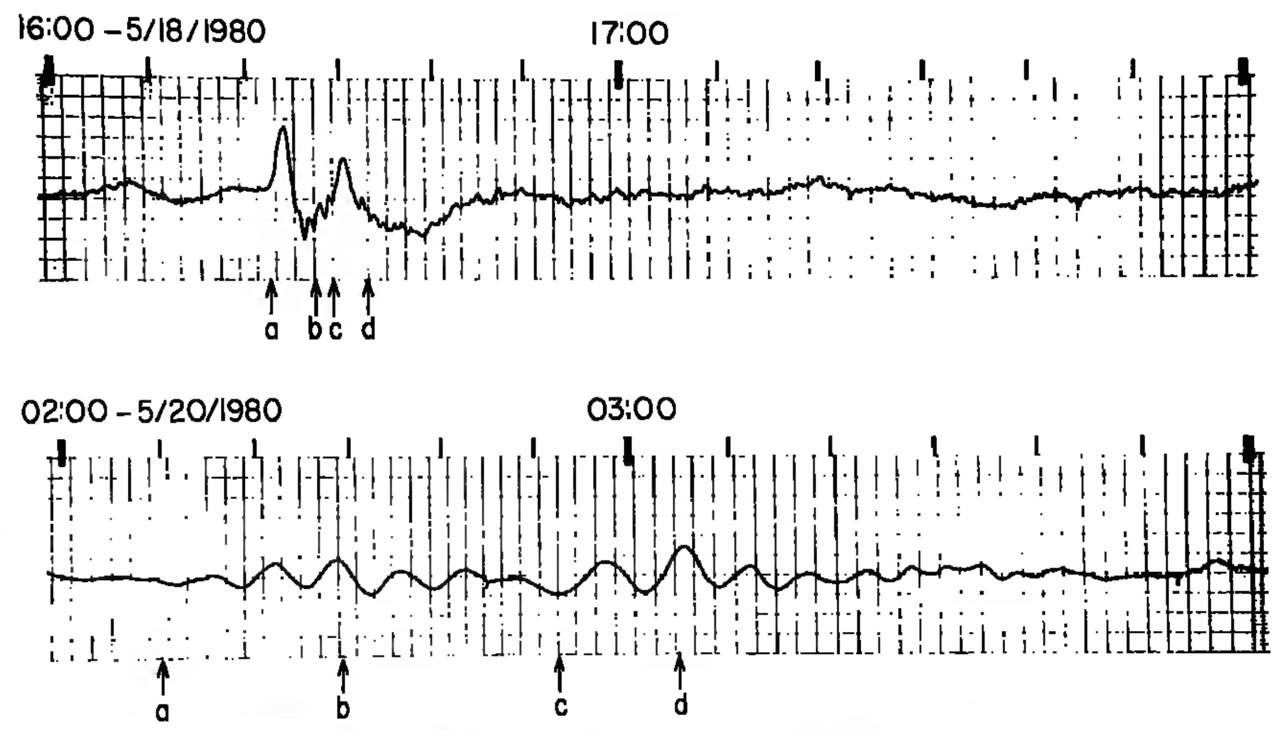

Fig. 1. Berkeley barograms showing atmospheric waves after the Mount St. Helens eruption, May 18, 1980. The top record shows the A1 wave train that begins 50 min after 1532 UT; the bottom record shows the antipodean A2 train that begins 34 hours and 38 min after 1532 UT.

Over 33 hours later, a more-or-less monochromatic train of air waves arrives at Berkeley, as shown in the lower part of Figure 1. The train onset (A2a) corresponds to the GR_0 acoustic wave with a velocity of 314 m/s. The wave train remains at about 7-min period but with decreasing amplitude until, about 30 minutes later, amplitudes again rise to the maximum in this portion of the barogram. The pulse marked A2d has a velocity of 308 m/s if it is part of the A2 train. If, however, it corresponds to the circumnavigating antipodean train A3, its velocity would be 320 m/s. In fact the barogram shows wave motion continuing for about 30 min after the largest wave, and these later arrivals no doubt correspond to A3 waves of low amplitude that travel with velocities of about 315 m/s. The appearance of the doublet, therefore, on the lower record of Figure 1 is probably best explained as the superposition of the two wave trains A2 and A3.

Energy

The largest pressure variations at Berkeley in the A1 and A2 pulses were about 3.5 and 1.3 mbar, respectively (Table 1). The amplitude of the air wave associated with the pulse A1a is thus about 3.5 m. Knowledge of the wave amplitudes enables, by integration over the number of cycles and through the volume of atmosphere involved, an estimate of the energy carried by the atmospheric waves. Calculation indicates that this energy in the A1 train was at least 10^{22} ergs, a value verified by a similar calculation for the A2 train. This value is less than the De Bilt estimate [*Ritsema*, 1980] that the blast energy from the Mount St. Helens eruption was perhaps equivalent to that of a nuclear explosion of 10 MT of TNT. The present calculation suggests that this energy value may be on the high side. From the air pressure pulses recorded after the Krakatoa explosion, Pekaris inferred 10^{24} ergs in the atmospheric oscillations [*Wilkes*, 1949], and later, *Press and Harkrider* [1967] suggested an equivalent surface explosion at Krakatoa of about 100 to 150 MT.

Wave Phase	Period, min	Velocity, m/s	Amplitude, mbar
A1 *a*	5	308	3.5
b	14	266	2.2
c	6	262	
d	18	254	
A2 *a*	6	314	
b	7	311	
c	9	307	
A3 *d*	65	306 (320)	1.3

A1 epicentral distance 925 km.
A2 epicentral distance 39,106 km.
Azimuth from Berkeley.

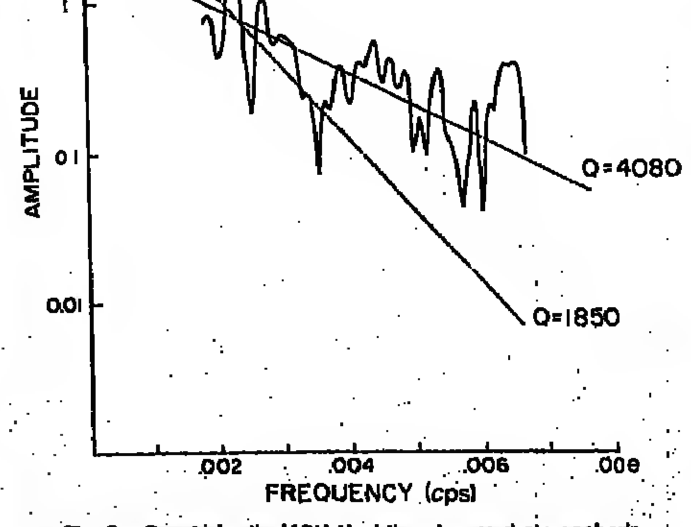

Fig. 2. Spectral ratio (A2/A1) of the observed atmospheric wave trains. The straight lines are alternative plausible fits to the slope of the spectral curve.

Attenuation

The relative amplitudes of the A1 and A2 wave trains also provide an estimate of the mean attenuation of the atmospheric waves. Straight lines drawn on Figure 2 indicate the range of fits to the decay in the amplitude spectrum.

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Cover. A scatter plot of some 30,000 first-arrival times of seismic waves that have traveled through the earth's core, as reported in the 1967 Bulletin of the International Seismological Centre (ISC). This plot has been used to study, in greater detail than possible previously, the form of the travel-time curve of seismic waves that pass through the core-mantle boundary (cf. Andersen, R. S., and J. R. Cleary, *Phys. Earth Planet. Int.*, 23, 207–214, 1980).

The slopes give a measure of the attenuation factor Q (equal to the number of oscillations for the decaying harmonic wave to fall to 100/exp π = 4.3% of its initial value). The curves indicate a Q of between 2000 and 4000, with the lower value preferred because of the possible contamination by A3. This value is not inconsistent with observations of the Mount St. Helens air waves by Knopoff (personal communication, 1980). These observations were based on an ultra-long-period seismograph at UCLA that recorded the A1 wave but only marginally the A2 train.

More detailed investigation of the present records and source properties requires a correlation between barograms at worldwide stations [*Ritsema*, 1980]. The present records are available to investigators for this purpose.

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Bruce Bolt has had a distinguished career. He obtained his B.Sc (with honors) from the University of Sydney in 1952 and his Ph.D. from the same university in 1959. He has been a Fulbright scholar and a Fellow of the American Geophysical Union. He holds many prestigious academic, research, and honorary posts, including the presidency of the International Association of Seismology and Physics of the Earth's Interior.

Toshiro Tanimoto received his M.S. in geophysics from the University of Tokyo in 1979. He is currently a Ph.D. student in geophysics at the University of California, Berkeley, and is working on various theoretical aspects of wave propagation in the earth.

News

An Extraordinary SAR Arc Event

For at least the first 12 hours of March 6, 1981 (UT), the nightside earth was encompassed by an extraordinary example of a Stable Auroral Red (SAR) arc (see figure); one of the more intense of the last several years. Initial analysis of data received from several ground stations indicates 6300-Å (O(¹D)) emission intensity of 2 to 2.5 KR, which remained rather constant throughout a major portion of the local evening and morning sectors. Interestingly, the arc dimmed significantly prior to morning twilight, perhaps as a result of reduced energy input or the diurnal variation of thermospheric composition. Simultaneous measurements from various latitudes yielded estimates of altitude of maximum emission and location which are 400–500 km and L = 2.8, respectively.

Of particular note in this event was the extremely pronounced separation from the more northerly auroral precipitation seen in the Figure, a separation in excess of 4 L-shells.

Those interested are urged to contact the Space Sciences Section, Battelle, Pacific Northwest Laboratory, P.O. Box 999, Richland, WA 99352 (telephone 509/376-7301).

This news item was contributed by Donald W. Slater and Edward W. Kleckner of Battelle's Pacific Northwest Laboratory.

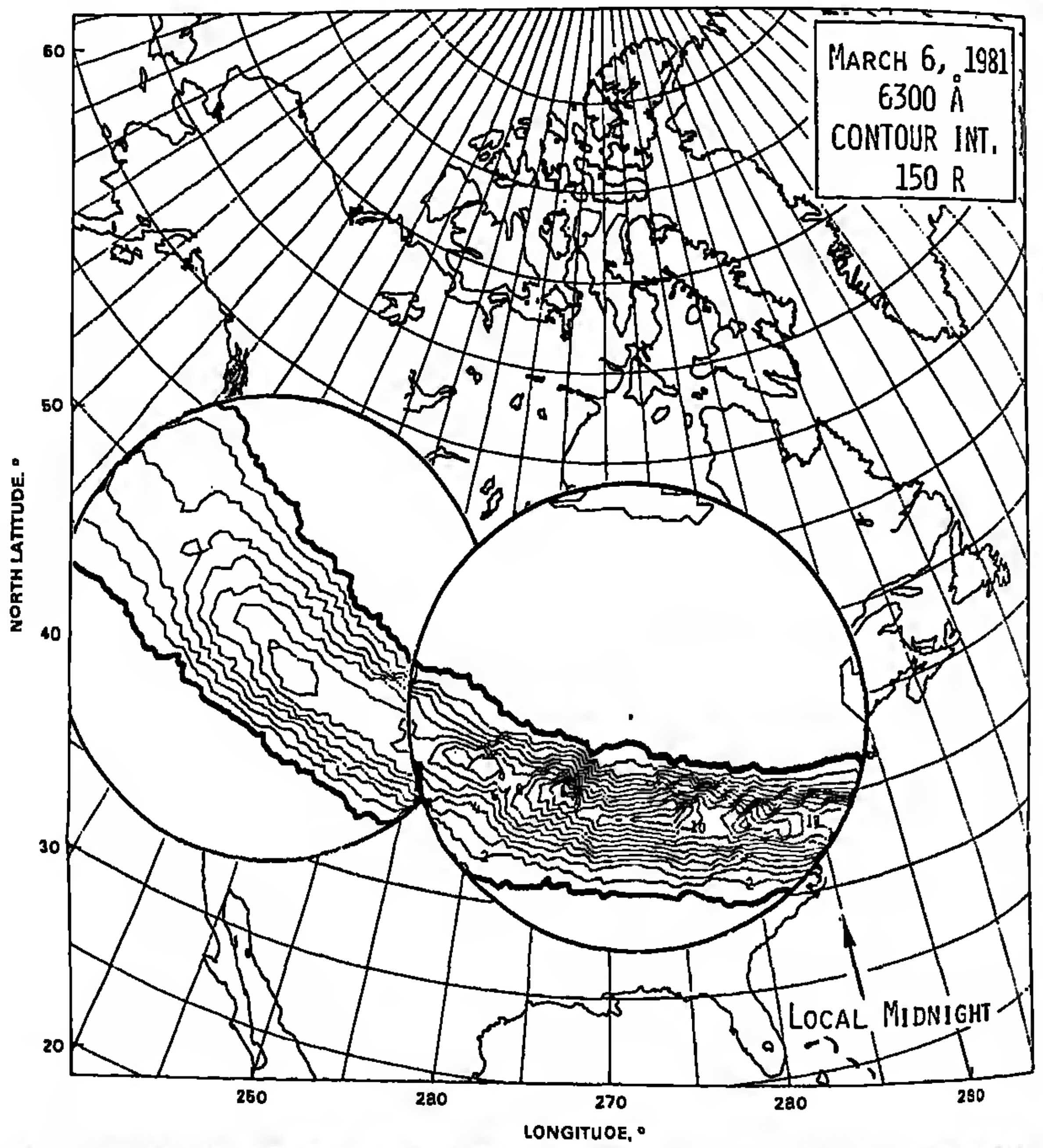


Fig. 1. Contour plots of 6300-Å emission during March 6, 1981 SAR arc event (0500 UT). Arc is depicted as occurring at 425 km; contour interval is 150 Rayleighs. Circles of observational coverage are centered at the photometer sites in the states of Washington and Michigan. Note that local midnight is located at 285°E longitude.

Crustal Deformation Observatory

Under the joint direction of the University of California at Los Angeles and San Diego, the Crustal Deformation Observatory project at Pinyon Flat, California, has completed its first year. The overall aim of this project, sponsored by the U.S. Geological Survey, is to evaluate and improve instrumentation for measuring long-period (days to years) crustal deformation in a tectonically active area. This research is being conducted at Piñon Flat Observatory by operating an array of differing instruments, each capable of resolving the signals generated by stresses associated with the San Jacinto and San Andreas fault zones. At this time there are 11 institutions involved, some on an informal basis, utilizing techniques ranging from NASA's project ARIES to Carnegie Institute's deep borehole strainmeters. Particular emphasis has been placed on establishing the coherence between different methods of long-baselength (500 m) tilt measurements. Other investigators are welcome to participate in studies at the observatory. For more information, please contact D. Jackson (UCLA) or F. Wyatt (UCSD).

This news item was contributed by Frank Wyatt of the Institute of Geophysics and Planetary Physics at the University of California in San Diego.

Geophysical Events

This is a summary of the *SEAN Bulletin*, 6(4), April 30, 1981, a publication of the Smithsonian Institution. The complete bulletin is available in the microfiche edition of *Eos*, as a microfiche supplement, or a paper reprint. For the microfiche, order document number E81-001 at $1.00 from AGU, 2000 Florida Avenue, N.W., Washington, D.C. 20009. For reprints order *Sean Bulletin* (give dates and volume number) through AGU Separates: $3.50 for the first copy for those who do not have a deposit account; $2 for those who do; additional copies are $1.00. Orders must be prepaid.

Volcanic Events

Alaid (Kurile Is.): Strong explosive eruption; ashfalls to more than 1000 km.

Pagan (Mariana Is.): Large tephra cloud; lava flows; 53 evacuated.

Mt. St. Helens (Washington): Steam and ash emission; more data on dome extrusion.

Piton de la Fournaise (Reunion Is.): Lava flows, bombs, and ash from fissure vents.

Hekla (Iceland): Lava extrusion and ash ejection from summit crater.

Krafla (Iceland): Slow inflation continues.

Bulusan (Philippines): Ash ejection and seismicity.

Sakurazima (Japan): Fewer explosions.

Tarumai (Japan): Minor ash emission during February seismic peak.

Langila (New Britain): Dark ash clouds and glow.

Manam (Bismarck Sea): Ash and incandescent lava fragments.

Alaid Volcano, Northern Kurile Islands, USSR (50.86°N, 155.50°E). All times are local (GMT + 11 h). Soviet volcanologists reported that an explosive summit eruption from Alaid, located on uninhabited Atlasova Island in the Kurile group, began after midday on April 27 and intensified the next day. Much of the information on the eruption is from both U.S. and Soviet sources, ie from analysis of satellite imagery. Clouds prevented satellite observations until about 0715 on the 28th when infrared imagery from the NOAA 6 polar orbiter revealed a distinct V-shaped eruption plume that extended NE from the volcano for a short distance before disappearing in heavy weather clouds. An infrared image returned from the Japanese geostationary weather satellite at 1100 showed a similar pattern. Microbarographs at Kushiro Weather Observatory (about 1250 km SW of Alaid) recorded three distinct pressure waves on April 26: at 1143 (0.5 mbar), 1153 (0.2 mbar), and 1340 (0.8 mbar).

Vigorous feeding of this cloud could be seen on the satellite imagery for the next 2 days. The imagery returned April 29 indicated that the plume consisted of two primary layers, at about 9 to 11 km and 13.5- to 15-km altitude. The last clear-weather image, on April 30 at 1700, showed a plume at least 120 km wide and 1900 km long. Eighteen hours later (1100 on May 1 and 4 days after the eruption began), partial clearing showed that feeding of the plume had apparently ended. Weather obscured the area on images returned from April 30 at 2300 until May 1 at 1100 when partial clearing showed that feeding of the plume had apparently ended.

Significant ashfalls were reported over a wide area. Soviet volcanologists reported that the ash, a pyroxene olivine basalt, fell as much as 1000 km from the volcano, over an area of 150,000 km². They noted an accumulation of 30 cm of ash 7 km from Alaid, and Tass reported that 20–25 cm fell on the town of Severokurilsk (45 km ESE of the volcano), where residents heard roaring noises and saw a glow from the volcano during the night. Schools were closed in Severokurilsk, and radio communication was disrupted. Ash mixed with wet snow fell on Petropavlovsk (300 km NE of the volcano) and other inhabited areas on the Kamchatka Peninsula. In the Aleutians, ashfall began April 28 on Shemya (about 1200 km ENE of Alaid) and lasted all day April 30 and May 1 when roughly 2 mm of ash were measured in very windy weather. Lt. Becker observed intermittent ashfalls and periods of acid rain between May 2 and 5, always within 1½ hours after low ocean tide. Ash collected at Shemya was sent to the NASA Ames Research Center. Daily precipitation sampling from Adak Island (850 km E of Shemya and 1900 km from Alaid) May 1–7 yielded only a trace of ash, on the 4th.

Tass reported that volcanologists overflew the volcano April 29 and observed an ash column that rose to about 10-km altitude from the summit crater. Soviet volcanologists later reported a maximum eruption cloud height of 12 km during the activity, based on overflights and analysis of satellite imagery.

Soviet volcanologists reported that activity declined May 2-4. No additional activity was observed on satellite imagery until May 6 at 2300, when the Japanese weather satellite recorded a new eruption column starting to emerge from Alaid. Careful examination of earlier imagery from other satellites indicates that the renewed activity may have started as early as 1930. By May 9 at 0300, a dense plume extended more than 120 km to the ESE. This plume remained shorter and much narrower than the late April clouds, reaching a maximum length of about 400 km to the ESE of the volcano. Imagery from the Japanese weather station continued to show strong feeding of the cloud at 1100, but the eruption seemed to be weakening by 1400 and had apparently ended by the time of the next available image at 2000.

Attempts to observe and sample the Alaid ejecta farther downwind continue. During the night of May 6–7, LIDAR (laser radar) operated by SRI International near San Francisco, California, detected the distinct layers of material at 11.9- and 12.8-km altitude, just below the tropopause. However, it was not possible to confirm that this material was of volcanic origin.

A preliminary search for strong seismicity associated with the eruption yielded only a single shallow magnitude 6.0 event at 44.04°N, 149.93°E (860 km SSW of the volcano), which occurred on May 1 at 0142.

Alaid's last eruption, in 1972, produced large tephra clouds and lava flows that reached the sea from NW flank vents. Its last summit eruption was in 1894.

Information contacts: S. Fedotov, Director, and Dr. Ivanov, Institute of Volcanology, Piip Avenue 9, Petropavlovsk, Kamchatskii 683006 USSR; Frank Smigielski and Steven Arnett, NOAA/National Environmental Satellite Service, Synoptic Analysis Branch, S/OP33, Camp Springs, Maryland 20233; Michael Matson, NOAA/National Environmental Satellite Service, Land Sciences Branch, Camp Springs, Maryland 20233; Gus Telegadas, Room 617, NOAA/Air Resources Laboratory, Silver Spring, Maryland 20910; Daisuke Shimozuru, Earthquake Research Institute, University of Tokyo, Bunkyo-ku, Tokyo 113, Japan; Robert Muñoz, NASA, Ames Research Center, Moffett Field, California 94035; M. P. McCormick, NASA, Langley Research Center, Hampton, Virginia 23665; Philip B. Russell, Senior Physicist, Atmospheric Science Center, SRI International, 333 Ravenswood Avenue, Menlo Park, California 94025; Lt. Becker, Wing Weather Commander, U.S. Air Force Base, Shemya, Alaska; Tass, Soviet News Agency; National Earthquake Information Service, U.S. Geological Survey, Stop 967, Denver Federal Center, Box 25046, Denver, Colorado 80225.

Mt. St. Helens Volcano, Cascade Range, Southern Washington, USA (46.20°N, 122.18°W). All times are local (GMT − 8 h through April 25 and GMT − 7 h thereafter). Although deformation measurements showed that the magma rose through a conduit beneath the central collapse pit of the preexisting dome, the April lava emerged from a vent somewhat N of the central pit, covered roughly the N quarter of the older material, and extended about 160 m NNW from its previous margin. After the April event, the dome had a volume of about 15 × 10⁶m³, maximum and minimum lateral dimensions of 630 m (NNW–SSE) and 310 m (E–W), and a maximum height above the crater floor of 110 m. A substantial but uncertain amount of uplift of the entire crater floor was associated with the April extrusion, and some points on the crater floor spread away from the dome as much as 1.5 m, with most of the movement occurring during extrusion. One radial fissure exhibited about 55 cm of strike-slip movement during the episode. As of May 5, only a few mm of additional deformation had taken place within the crater. No net deformation of the volcano as a whole has been associated with any of the extension episodes.

In the weeks following the April extrusion, characteristic low-level seismicity was recorded that could sometimes be correlated with witnessed bursts of steam emission. Simultaneous seismicity and ejection of steam containing a little ash occurred on April 13 at 0842; April 14 at 0950, 0953, and 1021; April 17 at 0956; and April 24 at 1016. Seismicity accompanied ejection of plumes of steam (without ash) on April 25 at 0921 and April 26 at 0621. A small amount of ash that fell about 50 km SE of Mt. St. Helens on May 6 between 1500 and 1530 may have been ejected during a period of seismicity at 1415.

Information contacts: Don Swanson and Chris Newhall, U.S. Geological Survey Field Office, 301 E McLaughlin, Vancouver, Washington 98663; Christina Boyko, Steven Malone, Elliot Endo, and Craig Weaver, Graduate Program in Geophysics, University of Washington, Seattle, Washington 98195; Robert Tilling, U.S. Geological Survey, Stop 906, National Center, Reston, Virginia 22092.

Earthquakes

Date	Time, GMT	Magnitude	Latitude	Longitude	Depth of Focus	Region
Apr 18	0032	5.1 m_b	12.21°S	74.65°W	shallow	Central Peru
Apr 24	2150	7.0 M_s	13.19°S	166.36°E	shallow	Vanuatu Islands, S Pacific
Apr 26	1209	5.7 M_s (5.6M_L Pasadena)	32.99°N	115.68°W	5 km	California-Mexico border
Apr 27	1817	6.5 M_s	57.81°S	149.03°E	10 km	W of Macquarie Island, Southern Ocean

Four persons were killed and 15 injured April 18 in Peru; damage occurred around the city of Ayacucho, about 300 km SE of Lima. The earthquake in the Vanuatu Islands (formerly the New Hebrides) was centered at the NW end of the Loyalty Island group, a sparsely populated area. No damage or casualties were reported. The April 26 event shook a wide area across S California to Yuma, Arizona, and caused damage in the vicinity of Westmorland, California. The epicenter of the April 27 earthquake was in open ocean about 350 km WSW of Macquarie Island.

Information contact: National Earthquake Information Service, U.S. Geological Survey, Stop 967, Denver Federal Center, Box 25046, Denver, Colorado 80225.

Meteoritic Events

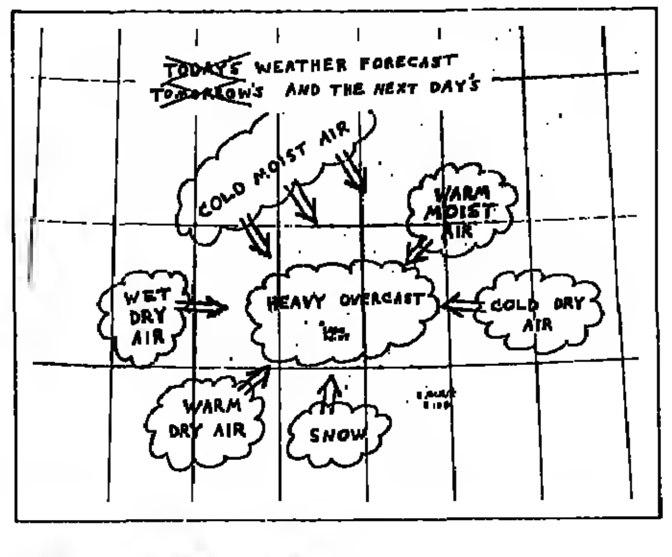
Meteorite fall: Yemen, January 7.

Fireballs: SE United States, Oklahoma, Pennsylvania, Brazil.

Meteorite Fall

Yemen, January 7. A. N. Simonenko reports that a meteorite fell about 450 km from Aden, S Yemen (direction not given). The meteorite, probably a carbonaceous chondrite, is now in the hands of the Committee on Meteorites, USSR.

Information contacts: E. L. Krinov, Committee on Meteorites, Academy of Sciences, Ul. U. Ul'yanovoy 3, Korpus 1, Moscow 117313, USSR; A. N. Simonenko, Astronomical Council, Academy of Sciences, Pyatnitskaya 126, Moscow 109017, USSR.



Index to Water Data

The U.S. Geological Survey recently published the seventh edition of the index to the information catalog on surface and ground water data. The data, collected at more than 100,000 sites across the country, are based on information provided by federal, state, and local agencies. The index also includes data for parts of Canada and Mexico.

The catalog does not contain the actual data, but it does provide information on where and by whom data are being collected, the types of data acquired, and how to obtain the data.

The index is published in 21 regional volumes and is available free from the USGS. For more information about the index, contact the Office of Water Data Coordination, USGS, 417 National Center, Reston, VA 22092.

USNC/IUGG

The United States National Committee for the International Union of Geodesy and Geophysics has a close relationship with the AGU. They were born together in 1919 when the AGU was founded as a vehicle for U.S. participation in the IUGG. They separated in 1972 when the AGU became an individual corporate entity; the U.S. National Committee appropriately remained a part of the National Academy of Sciences.

The USNC/IUGG actively represents U.S. interests in the Union and assures U.S. participation in Union activities. It formulates and advances U.S. positions on a variety of administrative matters that require attention if the Union is to serve geophysics well. The dispute over how China was to be represented in the Union and whether Taiwan could be separately represented is a recent example of a question on which the committee took strong action. The committee also considers areas such as financing, voting, and distribution of publications. All member countries have one vote in the Union, except on financial matters, for which voting strength is roughly a log function of the dues one pays. On financial questions the U.S. has 10 votes, and the next highest countries have eight. At $24,000 per year the U.S. pays 50% more dues than the next highest countries, $16,000 for Great Britain, West Germany, and France; Russia and Japan pay $12,000 each and have seven votes.

Perhaps the most visible activity of the USNC/IUGG is its travel grant program, which is operated by the AGU. The USNC, with the cooperation of the AGU and the American Meteorological Society, seeks travel grants for the support of U.S. scientists attending assemblies of the Union and assemblies of any of the seven associations that make up the Union. If funds are made available, a subcommittee of

USNC/IUGG Membership

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the USNC will propose their allocation. These block travel grants permit the distribution of funds to a broader spectrum of individual scientists than would the normal procedures of federal agencies that make individual travel grants. In addition, the administrative load is substantially less, thus making available more money for travel. AGU assesses no overhead against travel grants and less than $30 for processing each grant made, even though each award may involve corresponding with an average of three to five applicants, committee review, report preparation, and follow-up.

The membership of the USNC/IUGG, shown in the accompanying box, still bears a close relationship to AGU. The president and the foreign secretary of AGU, as long as they are U.S. residents, sit as *ex officio* voting members of the committee. The AGU president also makes nominations to the president of the National Academy of Sciences from which are selected at least 10 of the 18 members appointed by the Academy.

Officers of the Union and of its associations who are resident in the United States are *ex officio* nonvoting members of the USNC. Their participation in the meetings of the Committee ensures that they are aware of the U.S. position on issues that may arise in their work as executives of the Union. The secretary for the USNC/IUGG is elected by the committee. Fred Spilhaus is currently serving his third 4-year term in that capacity, and the AGU contributes his time and all support services required for the national committee secretariat.

Currently the U.S. National Committee is focusing on the continuing need to justify the expenses associated with its participation in IUGG. The committee would welcome examples of the quantitative benefits of U.S. participation that would help make the case for continued substantial federal support. If you have had such valuable experiences please send details of them to Fred Spilhaus, Secretary, U.S. National Committee/IUGG, 2000 Florida Avenue, N.W., Washington, D.C. 20009.

The national committee exists to serve the interests of U.S. scientists. Individuals should feel free to contact any of the members of the committee to make their interests known; in turn individuals must be willing to provide their support to the committee when required. ⓢ

Geophysicists

William D. Bonner, deputy director of the National Weather Service, has been selected to succeed *Frederick G. Shuman* as director of the National Meteorological Center. The appointment is expected to be effective in August.

Peter E. Wilkniss was recently appointed director of the National Science Foundation's Division of Ocean Drilling Programs. He has been the division's acting director since its establishment in October 1980.

The following AGU members are recently deceased.
Minar R. Steckpole, 91. Life member, joined in 1935.
Emanuel Zies, 97, in April. Life Fellow, joined in 1929.

New Publications

Solar and Interplanetary Dynamics

M. Dryer and E. Tandberg-Hanssen (Eds.). D. Reidel, Hingham, Mass., xix + 558 pp., 1980, $55.00.

Reviewed by Kenneth H. Schatten

Solar and Interplanetary Dynamics, IAU Symposium 91, is a volume consisting of invited reviews and contributed research papers. The symposium, held during August 1979 in Cambridge, Massachusetts, was truly an international affair with more than half of the 133 participants traveling to the conference from overseas. They represented 23 countries. The book is intended for research scientists and advanced graduate students.

The book contains a preface, list of participants, the scientific papers presented at the conference (including valuable discussion), and, surprisingly, an index. The scientific papers are divided into eight sections: the life history of coronal streamers and fields, coronal and interplanetary responses to long time scale phenomena, solar transient phenomena affecting the corona and interplanetary medium (observations and theory sections), coronal and interplanetary responses to short time scale phenomena (observations and theory sections), future directions, and a summary of symposium 91.

I shall discuss some of the interesting papers in these sections; however, let me first give an overview of the book as a whole. Do not be mislead by the title. *Solar and Interplanetary Dynamics* deals principally with the outer layers of the sun, such as the corona and interplanetary medium in particular and dynamics and disturbances owing to flares etc. in those environments. Although many astronomers might not even regard these regions as belonging to "the sun" at all, many solar physicists similarly think of the interior as outside their realm. Luckily, the sun disregards both opinions. Thus the book contains little solar interior dynamics and would not be very useful to those interested in physics below the photosphere. Nevertheless, to those scientists interested, rather, in the solar atmosphere (and its influences upon the earth), this book provides much of the latest research and several good reviews. One unfortunate aspect is the relative dearth of U.S. papers. Perhaps when American scientists heard that the meeting was in Cambridge, many did not feel able to attend, thinking that overseas travel was required.

Section 1 leads off with a review by Levine on coronal and interplanetary fields that clarifies our present understanding as well as provides an historic perspective. Interesting papers by Le Bonte and Howard on their search for giant cells and many international findings on coronal holes are found therein. Section 2 contains a review by Sykora dealing principally with interpretations based upon the coronal FeXIV green line and by D'Uston and Bosqued on solar wind flow. Other articles show interesting work being done by the Israelis and the Russians.

Sections 3 and 4 deal with transient solar phenomena with reviews by Engvold on flares and eruptive prominences, wherein the energy and mass injected are estimated, and by Anzer on theoretical MHD aspects. A paper by Svestka et al. explains the particle emanation and other features from two-ribbon flares. Pneumann deals with theoretical aspects of this.

Other papers deal with spicules, filaments, flares, and transients. An exciting paper by Low shows that a usual assumption on force-free fields being in an equilibrium state is not necessarily true.

Sections 5 and 6 deal with transients within the corona and interplanetary medium. International work in this area has been particularly prolific. Further, in the interplanetary medium with several spacecraft at differing locations, it sometimes is possible to ascertain transients' three-dimensional structures. In section 7, on future directions, Williams outlined the OPEN program to study the earth's nearby space plasmas. Bohlin and Chipman outline NASA-proposed programs for studying the sun and heliosphere until 1995. These include SMM, solar polar, solar optical telescope, the Solar Cycle and Dynamics program, an advanced solar observatory, and the solar probe. Porsche et al. present an interesting German proposal to sound the solar corona.

Kuperus presents a review by raising questions pertinent to the meeting that he feels have been answered. One is the question of whether interplanetary sector boundaries extend into the photosphere. He states that it appears difficult to trace them back to the photosphere. On the question of magnetic structure, the potential field appears reasonable, yet the more general force-free field may not be an equilibrium solution. He points out the extensive work on coronal transients and summarizes the remainder of the meeting.

Dryer and Tandberg-Hanssen have done much to make the volume useful to researchers by providing a discussion section after each paper and an index to the entire volume.

Kenneth H. Schatten is with the Planetary Aeronomy Branch, NASA Goddard Space Flight Center, Greenbelt, Maryland.

Geodesy, 4th Ed.

G. Bomford, Clarendon, Oxford, xii + 855, 1980, £49.00.

Reviewed by Richard H. Rapp

In 1952, the first edition of this book was published. Later editions were published in 1962 and 1971. The current fourth edition has a publication date of 1980 and represents the approximately 10 year interval between the editions. Although dated 1980, the book was completed in December 1978 and includes references through 1977 or 1978.

To have a book encompassing all of geodesy is of course difficult. However, Bomford's *Geodesy* over the years has truly endeavored to cover the most relevant areas with sufficient detail for many purposes. The increasing breadth of coverage is judged by the increase of the number of pages from 452 in the first edition to 855 in the fourth edition. The book has 620 references and an excellent index.

In preparing the new edition, Bomford revised much of the previous edition. The revisions range from small changes in wording or the introduction of new constants to rearranging the order of material and to a substantial revision of the chapter dealing with artificial satellites. In many cases, however, the text is unchanged from the previous edition. In other cases, the text has been deleted and reference has been made to a prior edition containing the information. In addition, most all of the units of measure have been changed to that of the System International.

The first chapter, 'Triangulation, Traverse, and Trilateration (Field Work),' is of interest because of the discussion of the various techniques for establishing geodetic control and the instruments to be used for the measurements.

'Computation of Triangulation, Traverse and Trilateration' is the second chapter, and here the basic concepts of the ellipsoid and the adjustment of data on the ellipsoid are discussed. Various formulas for the computation of the direct and inverse problem are given. However, I have never understood why the excellent paper of Rainsford in 1955 is not referenced. A section discusses problems in the changing of the ellipsoid, but the discussion is restricted to ellipsoid parameter changes and datum translation effects. No consideration is given to axis rotations and scale differences between datums, although results are given for such effects in a later chapter.

Chapter 3, 'Heights Above Sea Level,' discusses the observational procedures that use spirit leveling and vertical angles. Refraction effects in both areas are discussed. A new discussion exists for the separation of the geoid and the ocean surface. The information on orthometric heights seems to be quite restricted, considering the many types of systems that exist and have been considered for use.

'Geodetic Astronomy,' chapter 4, includes the discussion on observation of astronomic quantities as well as the reduction of the measurements. The updating of stellar coordinates is now also discussed by using matrix expressions.

The next chapter, 'Gravity Observations,' discusses the gravimeter, the pendulum, and the new absolute apparatus for gravity measurements. The pendulum discussion is probably not necessary because of the problems with their use, but since such data still exist, a proper understanding of its limitations may still be helpful. IGSN71 is now described in this edition.

Chapter 6, 'Physical Geodesy,' deals with both the classical and the Molodensky techniques. This chapter gives some basic theory as well as new techniques for combining satellite and terrestrial gravity information for geoid undulation computations. However, no discussion is made of general truncation theory or techniques for computing the gravity vector in space. The application of least squares collocation techniques to problems of gravity is not discussed, although the concept of collocation is introduced in an appendix. The earth tide section is brief and is not substantially changed from the previous edition.

The final chapter, 'Artificial Satellites,' is perhaps the most extensively revised chapter from the previous edition. Observation techniques, data corrections, data processing, and the results are discussed. A lengthy discussion is devoted to satellite photographic techniques that for most applications today are of minor importance. New information has been added concerning lunar lasers, VLBI, and satellite altimetry.

The book also has 10 appendices on topics not covered in detail in the chapters. These topics include a discussion of the geometry of the spheroid, matrix algebra, Cartesian coordinates in three dimensions, theory of errors, vector algebra, complex numbers and conformal mapping, modulated waves and tellurometer ground swing, spherical harmonics, rotating axes, Coriolis force, and gravity reduction tables. These appendices are the same as in the previous edition. However, the section on theory of errors has been enlarged by the addition of sections on interpolation by least squares and collocation.

This book encompasses many different aspects of geodesy. It is by far the most comprehensive book of which I am aware that attempts to cover the whole subject matter. In some cases, if one needs great detail, you might consult an up-to-date book in the specific subject area. When such a book does not exist, Bomford's *Geodesy* provides an excellent alternative.

I have felt comfortable in consulting Bomford's *Geodesy* to find initial information and references on topics of specific interest. The book is a combination of a handbook (mostly) and a text book (partly). In some cases the reader is just given various equations (and their references) without proof. On the other hand, some detailed derivations are given. The new edition is simply an evolutionary change from the prior edition. Unfortunately, the price change is revolutionary, which may put the book outside the use of many readers, especially students.

Richard H. Rapp is with the Department of Geodetic Science, The Ohio State University, Columbus, Ohio.

New Listings

Items listed in New Publications can be ordered directly from the publisher; they are not available through AGU.

Advances in Hydroscience, vol. 12, V. T. Chow (Ed.), Academic, New York, x + 440 pp., 1981, $51.00.

Beyond the Atmosphere: Early Years of Space Science, H. E. Newell, NASA, Washington, D.C., xviii + 497 pp., 1980.

Mechanism of Graben Formation, J. H. Illies (Ed.), Elsevier, New York, viii + 288 pp., 1981, $65.75.

Problems of the Arctic and the Antarctic, vol. 48, A. F. Treshnikov (Ed.), Oxinian Press, Faridabad, India, viii + 173 pp., 1981 (Available from NTIS, Springfield, Virginia.)

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EOS offers classified space for Positions Available, Positions Wanted, and Services, Supplies, Courses, and Announcements. There are no discounts or commissions on classified ads. Any type that is not publisher's choice is charged for at display rates. EOS is published weekly on Tuesday. Ads must be received in writing on Monday 1 week prior to the date of the issue required.

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Postdoctoral Research Associate. The Department of Civil Engineering, University of Washington has an immediate opening for a temporary, one-year post doctoral position in water resources and hydrology. Successful applicant will participate in ongoing projects in rainfall-runoff modeling, hydrologic forecasting, and stochastic hydrology. Concurrent independent research on related problems in hydrologic and water resources systems analysis will be encouraged. Please direct transcript, references, and vitae to: Stephen J. Burges or Dennis P. Lettenmaier, Department of Civil Engineering FX-10, University of Washington, Seattle, Washington 98195. (Telephone: 206/543-7135 or 543-2532).

The University of Washington is an affirmative action/equal opportunity employer.

Faculty Position
OCEANOGRAPHY

Applications are invited for a tenure-earning faculty appointment in physical oceanography; level of appointment and salary commensurate with qualification. Applicant should have a record of scholarly publications demonstrating the ability to interpret oceanographic observations. Duties include teaching graduate level courses in physical oceanography and supervising research of graduate students. Send curriculum vitae, publication list, and names of three references to: Dr. Friedrich Schott, Chairman, Division of Meteorology and Physical Oceanography, Rosenstiel School of Marine and Atmospheric Science, University of Miami, 4600 Rickenbacker Causeway, Miami, Florida 33149.

The University of Miami is an affirmative action equal opportunity employer.

Structural Geology/University of Illinois at Champaign-Urbana. The Geology Department is seeking a structural geologist for a tenure-track (assistant professor) faculty position. A Ph.D. is required. Salary open. The successful candidate will be expected to teach advanced undergraduate and graduate courses in structural geology and establish a research program. For equal consideration, applications, including the names of three references, should be sent by August 1, 1981 to Dr. D. E. Anderson, Department of Geology, University of Illinois, 245 Natural History Building, 1301 West Green Street, Urbana, IL 61801, (217) 333-6713.

Position to be filled by 1-1-82.

The University of Illinois is an affirmative action/equal opportunity employer.

Geophysicist/Tectonophysicist. The Department of Geology and Geophysics at the University of Wyoming has a tenure track opening at the Associate Professor level for a geophysicist/tectonophysicist. An interest in velocity measurements and other physical properties of rocks is essential. Additional interest in crustal structure and plate tectonics is desirable. Applicant should be able to relate studies of physical properties to field relationships. Ph.D. required.

Applications will be accepted through July 15, 1981. Applicants should send a vita, including names of three references, to:

Professor R. S. Houston
Department of Geology/Geophysics
University of Wyoming
Laramie, Wyoming 82071

The University of Wyoming is an equal opportunity/affirmative action employer.

Faculty Positions/University of New Orleans. The Physics Department of the University of New Orleans invites applications for tenure track positions available August 1981. Rank and salary are to be commensurate with experience and training. The department has a policy of encouraging research activities in applied areas which are of mutual interest to the faculty and the local technical community. Candidates with background in computational physics, acoustics, and geophysics are especially encouraged to apply. Current research activities within the department include experimental atomic and molecular physics, solid state physics, cryogenic geophysics, hydrodynamics, and computational physics.

Applicants should send a resume to Professor Edward L. Gasson, Physics Department, University of New Orleans, New Orleans, LA 70122.

The University is an equal opportunity/affirmative action employer.

Research Seismologist/Solid Earth Geophysics. ENSCO, Inc. in Springfield, Virginia is seeking a Program Manager/Research Seismologist to support an expanding program in solid earth geophysics. Research areas will include: seismic network data processing associated with the detection, identification and location of natural and man-made seismic sources; earthquake characterization and source mechanism studies; explosion source characterization; and empirical studies using near field and far field seismic data. Experience in theoretical and observational seismology at regional and teleseismic distances, is highly desirable. Experience in digital time series analysis is desirable. Ph.D. in seismology is highly desirable, however, M.S. level with experience in earthquake and explosion seismology will be considered. Salary and benefits are extremely competitive. Resumes along with salary requirements should be submitted to the Personnel Department at the address below, Attention Code SAS, ENSCO, Inc., 5408-A Port Royal Road, Springfield, VA 22151.

Equal employment opportunity/AAP.

Seismology. Research associate position anticipated (September 1, 1981), telemetry monitoring project in Virginia. Problems focus on seismicity and neotectonics in the state. Prefer M.S. geophysicist with thesis in observational seismology, but others considered. Applications, transcripts and two letters of recommendation to: Dr. G. A. Bollinger, Seismological Observatory, VPI&SU, Blacksburg, Virginia 24061. Deadline for receipt of applications is August 1, 1981.

VPI&SU is an equal opportunity/affirmative action employer.

Postdoctoral Position in Geochemistry/Cosmochemistry, University of Arizona. Applications are invited for a postdoctoral research associateship in the Lunar and Planetary Laboratory at the University of Arizona. The associate will collaborate with Dr. William V. Boynton in ongoing investigations of the refractory inclusions in carbonaceous chondrites. The selected applicant will have major responsibilities to conduct mineralogical investigations to supplement existing neutron activation analysis studies. Experience with an electron microprobe is essential; experience with neutron activation is desirable. Facilities include a fully automated SEM microprobe, numerous gamma-ray detectors including a Compton-suppression spectrometer, several computers and a TRIGA reactor.

Applications, accompanied by a resume, statement of research interests, and complete bibliography, should be sent to Dr. William V. Boynton, Lunar and Planetary Laboratory, University of Arizona, Tucson, Arizona 85721. Letters of recommendation, directed as above, should be requested from at least three persons who are well acquainted with the applicant's accomplishments and potential. To receive full consideration, application materials should be received by August 31, 1981.

The University of Arizona is an equal opportunity affirmative action employer.

Faculty Position/Geophysics. The Department of Geological Sciences at the University of Texas at El Paso has an opening in geophysics which can be filled at either the assistant or associate professor level. The emphasis will be on obtaining a quality individual regardless of specialty. However, candidates who would complement existing programs in geothermics, crustal studies, seismotectonics, and regional geophysics tectonics will be given preference. The successful candidate must hold a doctoral degree and will be expected to maintain a high level of research activity and to be active in the geophysics graduate program which involves 15–20 students (roughly ½ doctoral candidates). The geophysics program is well equipped and enjoys good support from the university administration. The deadline for applications is July 15, 1981 with the position to be filled prior to September 1, 1982. Applications and three letters of reference should be sent to:

Dr. Robert F. Roy
Department of Geological Sciences
University of Texas at El Paso
El Paso, Texas 79968.

The University of Texas at El Paso is an equal opportunity/affirmative action employer.

Temporary Staff Positions in Isotope and Trace Element Geochemistry. The research program of the new Geochemistry Division at the Max-Planck-Institute for Chemistry in Mainz is oriented toward the geochemical structure and development of the earth's mantle. Our facilities include a new Varian MAT 261 automated solid source mass spectrometer (in addition to older instruments) for isotopic analysis of Nd, Sr, and Pb.

Available at the institute are also: electron microprobe, ion microprobe, INAA, XRF, spark source MS, and piston-cylinder apparatus. Applications are invited for geochemists with experience in isotope geology and petrologists with experimental experience in trace element partitioning. Appointments are normally made for two years, but a one year extension is possible.

Applications should be sent to A. W. Hofmann, Direktor Abteilung Geochemie, Max-Planck-Institute fuer Chemie, Postfach 3060, 6500 Mainz, F.R. Germany.

PLANETARY SCIENCE POSTDOCTORAL POSITIONS
University of Hawaii
Institute for Astronomy

The Institute for Astronomy anticipates one or more positions to be available in the fall semester 1981 at the postdoctoral level. The positions are full-time, federally funded and annually renewable for a maximum of three years, subject to availability of funds. The selected candidates will carry out theoretical and observational research on a NASA grant for ground-based planetary astronomy. Emphasis is placed on the outer planets and their satellites, comets, and asteroids.

Minimum qualifications are a Ph.D. in astronomy or related field with experience in theory and data interpretation in planetary science, with a proven record as a researcher as demonstrated by publications and recommendations of peers. Salary will be commensurate with qualifications.

Submit a curriculum vitae with a list of publications and arrange for two letters of recommendation to be sent to: Dr. John T. Jefferies, Director, Institute for Astronomy, 2680 Woodlawn Drive, Honolulu, HI 96822. Telephone (808) 948-8566.

Applications should be postmarked no later than August 15, 1981.

The University of Hawaii is an equal opportunity/affirmative action employer.

Research Coordinator PHYSICAL OCEANOGRAPHY

Skidaway Institute
Savannah, GA.

Skidaway Institute of Oceanography is seeking person with an oceanographic, meteorological or engineering background to join a research team investigating physical oceanographic processes on the continental shelf. This person must operate and maintain a remote oceanographic data acquisition system and must have experience with digital equipment and the processing of data originating from such equipment. He or she will be responsible for checking and calibrating sensors on a scheduled basis, for data editing and for data analysis.

Applicants should have an M.S. degree in a related field or have the equivalent in training and experience. Knowledge of time series analysis procedures and techniques, computer programming, and technical report writing are necessary skills. Independent research and publication of results will be encouraged.

Starting Salary: $16,600-$20,000 depending upon previous experience and qualifications. Send résumé including three references to: Dr. Jack Blanton, Skidaway Institute of Oceanography, P.O. Box 13687, Savannah, GA 31406. Phone (912) 356-2457/2453.

SKIO is an affirmative action/equal opportunity employer.

Director of Laboratories. The position involves management of the building that houses the Department of Earth and Space Sciences and its special facilities for research and education in astronomy and the earth sciences, administration of departmental budgets, and supervision of technical personnel. The Director of Laboratories reports directly to the Departmental Chairman. Candidates with administrative experience and a Ph.D. in the physical sciences strongly preferred. The position will be available October 1. The salary range is $22,000 to $27,000.

Please submit resume and arrange for three letters of reference to be sent to Dr. Michal Simon, Chairman, Department of Earth and Space Sciences, SUNY Stony Brook, Stony Brook, NY 11794.

SUNY Stony Brook is an equal opportunity affirmative action employer AK•79.

Crustal Seismology: Princeton University. Candidates with an interest in any of the following are invited to apply for research staff appointments:

1. Marine seismic data analysis and structure of oceans and ocean margins.
2. Narrow and wide angle reflection seismology applied to continental crustal geology.
3. Wave propagation theory and techniques of seismic data analysis.

Princeton University has an ongoing program for the creative reanalysis of existing multichannel reflection data—such as COCORP and USGS offshore data. Special projects are undertaken from time to time to collect field data in critical areas or to test new methods of data collection and analysis. A high performance 32 bit minicomputer system for data analysis and theoretical work is to be installed later this year.

Applicants should send curriculum vitae and a list of three references to:

Robert A. Phinney
Department of Geological and Geophysical Sciences
Princeton University
Princeton, NJ 08544

Or inquire: 609-452-4118.

Date of appointment and salary are negotiable.

Princeton University is an equal opportunity employer.

Phenomenologist: Los Alamos National Laboratory. Stress wave and porous flow phenomenologists to develop and use solid mechanics or porous and fluid flow computer codes used in containment evaluation for underground nuclear tests and in other geoscience research activities. Participate in planning and interpreting laboratory and field experiments to verify computational models. Communicate results to professional community. As appropriate, publish results in open literature. Occasionally, travel to remote sites. Participate in containment analysis of underground nuclear tests and function as containment phenomenologist for tests conducted by the laboratory.

Requires MS or PhD in geophysics, physics, applied mathematics, or related field, or equivalent relevant experience and education; professional experience in modeling using finite element or finite difference techniques; FORTRAN programming experience; good oral and written communication skills.

Send complete resume, in confidence to: James Trout, DIV 81-81, Los Alamos National Laboratory, P.O. Box 1663, Los Alamos, New Mexico 87545.

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Plasma Theorist. Depending on the availability of funds, the Center for Atmospheric and Space Sciences, Utah State University, could have a one year, postdoctoral position in theoretical plasma physics. Candidates should have a Ph.D. degree and a background in nonlinear plasma physics and computer modelling. The appointee will primarily be involved with the development of both 1-D and 2-D numerical models of double layers and electrostatic shocks. Please send a resume and the names of three references to R. W. Schunk, Physics Department, Utah State University, Logan, Utah, 84322. (Tel: (801) 750-2974). Application deadline is June 30, 1981. Position available August-September, 1981. Salary range commensurate with experience.

Utah State University is an affirmative action/equal opportunity employer.

Research Position in Chemical Oceanography. California Institute of Technology, Division of Geological and Planetary Sciences. The position of research fellow is being offered at Caltech for research in oceanography. Investigation of the isotopic composition of neodymium and rare earth abundances in sea water and sediments is now being carried forward. The mechanism of injection of REE into sea water will be studied. The differences in $^{143}Nd/^{144}Nd$ in various water masses (Piepgras *et al.*, Earth and Planet. Sci. Lett. *45*, 223–236 and Piepgras and Wasserburg, Earth and Planet. Sci. Lett *50*, 128–138 (1980)) is now being carried forward as an exploratory venture in order to determine the origin and chemical behavior of REE in the ocean and the potential use of $^{143}Nd/^{144}Nd$ as a tracer. The laboratory facilities for sample preparation and analysis are fully functional and will be available. Applicants should have training in oceanography and a good perspective on general physical oceanographic models.

Send resume and references to Professor G. J. Wasserburg, Lunatic Asylum, California Institute of Technology, Pasadena, CA 91125.

Caltech is an equal opportunity/affirmative action employer (M/F/H).

Sedimentologist or Sedimentary Petrologist/University of California, Santa Barbara. Applications are invited for a tenure track appointment in soft rock geology to be filled in 1981–82. Rank dependent on qualifications and experience but preference will be given to the assistant professor level. Applicant should normally have a Ph.D. and strong field-orientation and quantitative background. The candidate will be expected to develop a strong research program in clastic sedimentation as related to basin analyses. The candidate will also be expected to teach at both undergraduate and graduate levels and interact with students and faculty of the department, particularly in the general areas of clastic diagenesis, volcanic processes, paleomagnetics, as well as field geology. Additional duties may include teaching physical geology and summer field geology.

Please send resume, other documentation of abilities, and four letters of recommendation by August 31, 1981 to Dr. Arthur G. Sylvester, Chairman, Department of Geological Sciences, University of California, Santa Barbara, CA 93106. Telephone (805) 961-3158.

The University of California is an affirmative action/equal opportunity employer.

Physical Oceanographer/ Geophysical Fluid Dynamicist

Areté Associates, a growing research firm, located in Southern California, engaged in theoretical and empirical physical oceanography, is offering permanent, full-time positions. Candidates require Ph.D. (or equivalent experience) in physical oceanography or geophysical fluid dynamics. Salaries are competitive and negotiable, based on qualifications. Areté offers a fringe benefit package of superior quality. Qualified candidates should send résumé, salary history, and list of professional references to:

Personnel Administrator
Areté Associates
P.O. Box 350
Encino, CA 91316

An equal opportunity employer M/F.

COURSES

Applied Rock Mechanics. A short course on the applications of modern rock mechanics methods to civil and mining projects will be held July 12-18 at the University of California at Davis. Francois E. Heuze, leader of the rock mechanics project at the Lawrence Livermore Laboratory, will teach the course. Designed for engineers, geologists, and scientists, the course will focus on discussion and demonstration of practical tools used to observe, analyze, and design rock structures, including mines, caverns, tunnels, pits, slopes, and foundations. Fee is $475. For an application form, write the University Extension, University of California, Davis, CA 95616, or call Heuze (415/423-0363). Deadline for registration is July 3, 1981. Registration will be limited to 35 participants.

Meetings

New Listings

The last complete Geophysical Year listing ran in the May 26 *EOS*.

Boldface type indicates AGU cosponsored events.

1981

Oct. 7–9 John Muir Geophysical Society's Fourth Nonannual Meeting, Lake Arrowhead, Calif. (M. McNutt, USGS, Menlo Park, CA 94025.)

Oct. 19–22 Earth Impact Conference, Snowbird, Utah. Sponsors, Lunar and Planetary Institute, National Academy of Sciences. (Earth Impact Conference, Lunar and Planetary Institute, 3303 NASA Road 1, Houston, TX 77058.)

1982

Mar. 24–27 Conference on Earthquake Hazards in the Eastern San Francisco Bay Area, Hayward, Calif. Sponsors, USGS, East Bay Council on Surveying and Mapping, Calif. Div. of Mines and Geol., Woodward-Clyde Consultants, Calif. St. Univ. at Hayward. (Sue Hirschfeld, Dept. of Geological Sciences, California State University, Hayward, CA 94542.)

April 27–29 **Chapman Conference on Rainfall Rates,** Urbana, Ill. (Meetings, AGU, 2000 Florida Avenue, N.W., Washington, DC 20009.)

Aug. 2–6 Second International Symposium/Workshop on Solar-Terrestrial Influences on Weather and Climate, Boulder, Colo. Sponsor, Lockheed Palo Alto Research Laboratory. (Billy M. McCormac, Lockheed Palo Alto Research Laboratory, Dept. 52-13/B202, 3251 Hanover Street, Palo Alto, CA 94304.)

AGU Midwest Meeting

September 17–18
Minneapolis, Minnesota

Abstract Deadine: July 1
Convenor: V. Rama Murthy

Papers and posters originating in or pertaining to the region are solicited for the following special sessions:

Mantle structure and dynamics. Contact Geoffrey Davies or Clem Chase.

Rock water interactions: Hydrothermal processes and metallogenesis. Contact William Seyfried.

Precambrian crustal evolution of the North American continent. Contact Paul Weiblen.

Geomagnetism and paleomagnetism. Contact Subir Banerjee.

Hydrology in the mid-continental U.S. Contact H. O. Pfannkuch or E. C. Alexander, Jr.

Abstracts

Use standard AGU format (see page 20 of January 13 *Eos*) and send original and two copies of abstracts to AGU Midwest Meeting, 2000 Florida Avenue, N.W., Washington, D.C. 20009. Abstracts will be published in *Eos*, with a substantive meeting report after the meeting. There will be no abstract charge.

Pacific Northwest Regional Meeting

September 17–18, 1981

Central Washington University
Ellensburg, Washington

Abstract Deadline: July 15

Special symposia will be held on 'The Tectonics of the Columbia Plateau and Other Neogene-Quaternary Faults of the Pacific Northwest;' 'Stratigraphy and Structure of the Cascade Range;' and 'Studies of the Eruption of Mount St. Helens.'

To submit an abstract, use standard AGU format (see page 20 of January 13 *Eos*).

Send the original plus two copies to Bob Bentley, Secretary-Treasurer, PNAGU, Central Washington University, P.O. Box 1000, Department of Geology, Ellensburg, Washington 98926.

If you are not an AGU member, or if you are an AGU member who lives outside the Pacific Northwest region, and you wish to attend, write to Bob Bentley to have your name put on the mailing list. The call was published in *Eos*, February 24.

GAP

Particles and Fields—Ionosphere

5515 Aurora
CHARGED PARTICLE DISTRIBUTIONS AND ELECTRIC FIELD MEASUREMENTS FROM S3-3

P. F. Mizera (The Aerospace Corporation, P.O. Box 92957, Los Angeles, CA 90009) J. F. Fennell, D. R. Croley, Jr., and D. J. Gorney

5515 Aurora
CHARACTERISTICS OF THE INSTANTANEOUS AURORAL OVAL IN THE 12-18 MLT SECTOR

J.S. Murphree, L.L. Cogger and C.D. Anger (Department of Physics, University of Calgary, Calgary, AB, Canada, T2N 1N4)

J. Geophys. Res., Blue, Paper 1A0802

5515 Aurora
ROCKET-BORNE OBSERVATIONS OF ION CONVECTION AND ELECTRIC FIELDS IN DAYSIDE AND NIGHTSIDE POLAR AURORAL ARCS

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Washington, D.C. 20009

particle precipitation, the optical morphology of the aurora, as well as the topology of the geomagnetic field. Both in the postnoon and pre-midnight sectors, it was observed that (1) equatorward of the region(s) of precipitation, the ion flow was predominantly westward, with velocity of about 1 km/s, (2) poleward of the regionfal, the flow was predominantly eastward, (3) the change in the flow direction, where observed, occurred near though not exactly at the edges of the precipitation region, (4) the flow inside the precipitation region was lower, (5) the reversal of the ion flow, where observed, occurred on closed magnetic field lines, and (6) the convective electric field typically dropped from 40 to 60 mV/m outside the precipitation region to 10 to 30 mV/m within. In the double Cape Parry flight where quantitative photometric measurements were available, detailed anticorrelation between the ion convection speed and the green line emission intensity was also observed. (Ion convection, auroral electric fields, dayside cleft, auroral arcs).
J. Geophys. Res., Blue, Paper 1A0640

5515 Aurora
AURORAL ELECTRON BEAMS: ELECTRIC CURRENTS AND ENERGY SOURCES

R.L. Kaufmann (Dept. of Physics, University of New Hampshire, Durham, N. H. 03824)

The equipotential structures and electron beams seen during rocket flight 18:152 are analyzed. The equipotentials which lead to beam formation can be produced by either a maximum in the high ...

oppositely directed field-aligned current sheets associated with the arc edges was inferred. However, these current sheets were not detected by the rocket-borne vector magnetometer. The magnetometer measured a downward current in the diffuse aurora equatorward of a wide region of upward current within which the arc was embedded. The differences in the field-aligned current patterns inferred from the two methods are attributed either to a time dependent field-aligned current profile or east-west current divergence in the region of the Harang discontinuity. (Auroral arcs, field-aligned currents, electrojets, neutral winds).
J. Geophys. Res., Blue, Paper 1A0740

5515 Aurora
AURORAL ELECTRON BEAMS: STABILITY AND ACCELERATION

R. L. Kaufmann (Dept. of Physics, University of New Hampshire, Durham, N. H. 03824) and G. R. Ludlow

Electron beams are identifiable groups of electrons that occasionally are seen streaming along the magnetic field over active auroral arcs. High energy beams appear at the outer edges of the plateaus in distribution functions. Low energy beams are imbedded well within a broad distribution function, and usually are seen when the rocket is near the edge of an arc. The present analysis shows that the observed distribution functions containing low energy beams are unstable to upper hybrid waves in the immediate vicinity of the rockets. The most unstable waves have growth lengths and perpendicular wavelengths of 0.3 km. Electrostatic whistlers with wavelengths and growth lengths of several kilometers may grow well above the rocket. These growth lengths are too long to destroy the observed beams through quasilinear or nonlinear processes. It is concluded that electrons are accelerated in a parallel electric field associated with closed or U-shaped equipotentials. The electrons become unstable during or after acceleration, and form plateaus plus residual high energy beams. Low energy beams involve acceleration of cold ionospheric electrons that enter the acceleration region above open equipotentials at the edge of an arc. (Auroras, beams, plasma instabilities, acceleration).
J. Geophys. Res., Blue, Paper 1A0690

5517 Interactions between waves and particles
GENERATION OF ION-CONIC DISTRIBUTIONS BY UPGOING IONOSPHERIC ELECTRONS

P. B. Dusenbery (Space Environment Laboratory, NOAA/ERL, Boulder, CO, 80303, USA) and L. R. Lyons

Downward currents in auroral regions are commonly measured with amplitudes of 1-5 μA/m². Such currents are likely the result of upgoing thermal ionospheric electrons falling through a field-aligned potential drop on the order of their thermal energy. Similar distributions of upgoing ionospheric electrons may also occur in regions of diffuse auroral electron precipitation to preserve current continuity in the presence of the loss of the precipitating electrons to the ionosphere. The drift velocity of the upgoing electrons is sufficient to excite electrostatic ion-cyclotron waves. In addition to being in Landau resonance with the upgoing electrons, these waves cyclotron resonate with the upgoing thermal ions with a parallel energy of several eV. Calculated quasi-linear diffusion rates using measured wave spectra indicate that resonant ions can be heated to perpendicular energies on the order of 100 times the initial for thermal energy. Comparison with auroral particle observations, both at low altitude (~ 1500 km) and higher altitude (~ 6000 km) shows that ion-conic distributions can readily be explained by such quasi-linear diffusion. ...

5545 Ionospheric disturbances
GENERATION OF SMALL-SCALE FIELD-ALIGNED IRREGULARITIES IN IONOSPHERIC HEATING EXPERIMENTS

5545 Ionospheric disturbances
GENERATION OF ION-SCALE IRREGULARITIES DURING THE KIDNIGHT COLLAPSE AT ARECIBO

Geomagnetism and Aeronomy
Volume 19, Number 6

Brief Information

Letters to the editor